Title: Playing in a Geo-World

#### Link to Outcomes:

• **Problem Solving** Students will demonstrate their ability to solve problems in mathematics including problems with open-ended answers and problems which are solved in a cooperative atmosphere.

• **Communication** Students will demonstrate their ability to communicate mathematically. They will read, write, and discuss mathematics with language and the signs, symbols, and terms of the discipline.

• **Reasoning** Students will demonstrate their ability to reason mathematically. They will make conjectures, gather evidence, and build arguments.

• **Connections** Students will demonstrate their ability to connect geometric concepts to architecture in the real world.

• Estimation & Students will demonstrate their ability to apply estimation strategies in computation, with the use of technology in measurement, and in problem solving. They will determine reasonableness of solutions.

• **Technology** Students will demonstrate their ability to solve problems using arithmetic operations with technology, where appropriate.

• Number Sense & Operations

Students will demonstrate their ability to describe and apply number relationships using concrete and abstract materials. They will choose operations and describe effects of operations on numbers.

• Geometry & Students will demonstrate their ability to describe and apply geometric relationships using one, two, and three-dimensional objects. They will demonstrate congruency, similarity, symmetry, and reflection and apply these concepts to the solution of the geometric problems.

• **Measurement**Students will demonstrate and apply concepts of measurement using standard units and customary units. They will estimate and verify measurements. They will apply measurement to interdisciplinary and real-world problem-solving situations.

• **Patterns &** Students will demonstrate their ability to recognize numeric and geometric relationships and will generalize a relationship from data.

• **Mathematical** Students will demonstrate a positive attitude towards mathematics and will value and appreciate the role of mathematics in school, culture, and society.

### **Brief Overview:**

This activity integrates geometric problem-solving with real-world architecture. Students will receive the task of designing and constructing a three-dimensional playground with given criteria. The students will also write to persuade. Students will apply their knowledge of geometry as they use a rubric to evaluate each group's model.

#### **Grade/Level:**

Grades 4-6

## **Duration/Length:**

This activity should take 2 to 5 days.

## Prerequisite Knowledge:

- Students should be able to identify and construct various types of angles and polygons.
- Students should be able to find the perimeter of a given shape.
- Students should be able to use customary units of measurement.
- Students should be familiar with scale drawings.

# **Objectives:**

- Construct a rectangle with given dimensions.
- Determine appropriate scale.
- Design and construct equipment to meet criteria.
- Use a rubric to evaluate a model.
- Write a persuasive letter.

# **Materials/Resources/Printed Materials:**

#### Materials for teacher

- Models to show scale (model car, globe, blueprints, maps)
- Four yardsticks
- Copy of Resource Sheet #1
- Transparency of Resource Sheet #1

### Materials per group of four

- Styrofoam 12" by 36"
- Toothpicks
- Gumdrops/mini-marshmallows
- Pretzel sticks
- Coffee stirrers
- Pipe cleaners
- Clay
- Large paper
- Compass
- Craft sticks

<sup>\*</sup>These are suggested materials. Cooperative groups may add or delete to meet their needs.

# Materials per individual

- Scissors
- Glue
- Pencil
- Ruler
- Compass
- Protractor

## **Development/Procedures:**

# Day One

- Hand out and discuss Student Resource #1 "Geo-World Contest."
- Divide the students into groups of four.
- Distribute rulers, two pieces of large paper (four pieces of one-inch grid paper, Student Resource #2, may be used to modify the activity), calculators, and scissors to each group.
- Tell the students the playground is a 24' by 36' rectangle.
- Generate a discussion, using models and examples, to show the importance of using scale when making a model. Some suggestions follow:
  - Equipped with yardsticks, have a few students attempt to show the dimensions of the playground within the classroom.
  - From that activity, students should conclude that a model must be used to represent the actual size of the playground.
- Model two possible proportions that could be used.

```
Examples: 1'' = 1' so the model would be 24 inches by 36 inches 1'' = 2' so the model would be 12 inches by 18 inches
```

- In groups, ask the students to find as many of the other possibilities as they can.
  - 1'' = 3' so the dimensions would be 8 inches by 12 inches
  - 1'' = 4' so the dimensions would be 6 inches by 9 inches
  - 1'' = 6' so the dimensions would be 4 inches by 6 inches
  - 1'' = 12' so the dimensions would be 2 inches by 3 inches
- Have each group draw and cut out the possibilities on large paper.
- Select one student from each group to bring up one paper cut out, so that all six possibilities are represented on the board.
- Lead a discussion to decide the most appropriate model size, keeping in mind the size of the materials.

The scale 1''=2' is the most appropriate.

• At this time, each group should use a ruler to measure and draw the dimensions of the playground area using the scale 1'' = 2' on their large plain paper or grid paper.

# Day Two

- Review polygons, shapes, solid figures, and angles. Display some models of each.
- Review the criteria and rubric on Student Resource #1.
- Distribute paper, rulers, compasses, and protractors to each group.
- Instruct each group to design the equipment in order to meet the criteria. They should use plain paper to complete this part of the activity. Ask the group to draw its equipment on plain paper and paste it onto the rough draft playground outline.
- Remind the students to bring in any additional materials to use for their model on the following day.

# Day Three

- Place the building materials in a central location.
- Distribute each group's paper model and foam board.
- Keeping scale in mind, each group begins to construct its playground on foam board (Teacher may wish to cut the foam board in advance).

# Day Four

- Groups continue to construct and complete their three-dimensional models.
- Groups that complete their playgrounds early, may attempt the Extensions. (See Extensions/Follow-Up)

# Day Five

- Have each student write a persuasive letter to the P.T.A. convincing it that his or her model should be selected.
- Distribute Student Resource #3.
- Using Student Resource #4, each group judges and scores its classmates' models.

#### **Evaluation:**

Students can be evaluated based upon the following:

- group participation and performance. Check daily for individual participation, accountability, and on-task behaviors.
- understanding of geometric concepts.
- adherence to criteria.
- recognition of prescribed geometric figures when judging classmates' models.
- attention to form, audience, topic, purpose in their persuasive letters.

#### Extensions/Follow Up:

- Students may use *Logo Writer*<sup>TM</sup> or *Super Print*<sup>TM</sup> to design their playground.
- Students may create a sign to display at the entrance to the playground.
- Students may plan a grand opening.

# **Authors:**

Maureen O. Ames Carroll Manor Elementary School Baltimore County

Nancy J. Wagner Park Elementary School Anne Arundel County Rachelle L. Klein Lewisdale Elementary School Prince George's County

Brenda S. Shlian Hampton Elementary School Baltimore County

#### **GEO-WORLD CONTEST**

THE P.T.A. has announced a school-wide contest for the design of a new Geo-World Playground. Students will work in groups to develop and construct a model for the new playground. The Geo-World models must contain the following:

- four pieces of equipment
- proper dimensions of rectangular playground enclosed in a fenced area

# **Geometric Criteria:**

- two right angles
- one acute angle
- two triangles
- one hexagon or pentagon
- one solid figure (cube, rectangular prism, sphere, cylinder, cone)
- one circle
- one quadrilateral

\*

## **GEO-WORLD RUBRIC**

# **Exceptional**

- Playground has proper dimensions
- All four pieces of equipment
- All seven geometric criteria present
- Fence

# High

- Playground has proper dimensions
- All four pieces of equipment
- At least five geometric criteria present

## Medium

- Playground is a rectangle
- At least three pieces of equipment
- At least three geometric criteria present

#### Low

- Playground is a rectangle
- At least two pieces of equipment
- At least one geometric criteria present

Grid Paper					

# Geo Student Resource 3

# **Geo-World Writing Prompt**

Your team really wants to win the design contest. You decide to write a letter to the P.T.A. board persuading them to choose your model.

As you are writing your letter, think about safety, appearance, and age appropriateness for the equipment.

Check your letter for form, audience, topic, and purpose.

**Geo-World Evaluation** 

# **Geo-World Evaluation**

Group:	Group:		
Criteria:	Criteria:		
Four pieces of equipment	Four pieces of equipment		
Proper dimensions of rectangular playground	Proper dimensions of rectangular playground		
enclosed in a fenced area	enclosed in a fenced area		
Geometric Criteria:	Geometric Criteria:		
Two right angles	Two right angles		
One acute angle	One acute angle		
Two triangles	Two triangles		
One hexagon or pentagon	One hexagon or pentagon		
One solid figure (cube, rectangular prism, sphere, cylinder, cone)	One solid figure (cube, rectangle prism, sphere, cylinder, cone)		
One circle	One circle		
One quadrilateral	One quadrilateral		
Rubric: (Circle the level)	Rubric: (Circle the level)		
Exceptional	Exceptional		
Playground has proper dimensions	Playground has proper dimensions		
All four pieces of equipment	All four pieces of equipment		
All seven geometric criteria present	All seven geometric criteria present		
• Fence	• Fence		
High	High		
Playground has proper dimensions	Playground has proper dimensions		
All four pieces of equipment	All four pieces of equipment		
At least five geometric criteria present	• At least five geometric criteria present		
Medium	Medium		
Playground is a rectangle	• Playground is a rectangle		
• At least three pieces of equipment	• At least three pieces of equipment		
• At least three geometric criteria present	• At least three geometric criteria present		
Low	Low		
Playground is a rectangle	<ul> <li>Playground is a rectangle</li> </ul>		
• At least two pieces of equipment	• At least two pieces of equipment		
• At least one geometric criteria present	At least one geometric criteria present		
Evaluators:	Evaluators		